CHROMOSOMES AND THE SPECIES PROBLEM IN THE GENUS *VIBURNUM*

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IN 1914 *Viburnum fragrans*, the most beautiful of all winter flowering shrubs, was introduced into European gardens. Reginald Farrer[2] found it growing wild in the barren hills round Kai Chow in S. Kansu, North China. As a cultivated plant it had a long history in China judging from the fine old specimens Farrer described as growing in every temple and palace and hamlet in Kansu. It was a Royal flower in Peking and reached common hands only with the fall of the Imperial dynasty. Several varieties of this rose-coloured Viburnum have arisen in cultivation of which a white form is in the collection at Wisley. The plants introduced into England came from Jo-ni, a little Tibetan village on the foothills of the Min Sa Alps. In 1932, Simonet and Miedzyrzecki[6] reported the chromosome number of *V. fragrans* as $x = 8$; $2n = 16$. This was a new basic number for the genus *Viburnum* in which Sax and Kribs[5] had found only plants with $x = 9$; $2n = 18$. Yet a third basic number $x = 10$ was found by Sugiura[7] in *V. odoratissimum* ($2n = 40$) of China and India, an evergreen species, otherwise closely related to *V. fragrans*.

I had occasion to examine two garden hybrids of *Viburnum* and their parents in connection with their description for publication in the Botanical Magazine. The first was *V. Bodnantense*, a cross between the Himalayan species *V. grandiflora* and *V. fragrans* of Kansu. It had $2n = 16$ chromosomes. I found that *V. grandiflora* had like *V. fragrans*, also $2n = 16$ chromosomes. The chromosomes of the two species paired normally in the hybrid *V. Bodnantense*, pollen fertility being as high as 100 per cent. in this hybrid. The second hybrid I examined was *V. Juddii*, a cross between the Japanese species *V. bitchiuense*, and the closely related Korean species *V. Carlesii*. *V. bitchiuense* had $2n = 16$ chromosomes and *V. Carlesii* $2n = 20$, while the hybrid *V. Juddii* had

TABLE I

Chromosome numbers in species of Viburnum

Species	2n	Distribution
I. With *Paniculate inflorescence*		
(Deciduous, rarely evergreen)		
Section THYROSOMA $x = 8, 10$		
V. fœtens	16	N.W. Himalayas, Kashmir
V. grandiflorum	16	Himalayas, Bhutan
V. sieboldii	16	Japan
V. suspensum	16	Liukiu Islands
V. fragrans	16	Kansu
var. *alba*	32	Cult. Kansu
V. Henryi	48	Hupeh, Szechuan, Yunnan
V. erubescens	48	Szechuan, Hupeh, Nilgris, Himalayas
V. odoratissimum	40	India, China
II. With *Umbellate inflorescence*		
(Deciduous and evergreen)		
Section LANTANA $x = 8, 9, 10$		
V. bitchiuense	16	W. Japan
V. Mongolicum	16	E. Siberia, Kansu
V. Carlesii	20	Korea
V. buddleifolium	20	C. China
V. utile	18	C. China
V. lantana	18	Europe, W. Asia
V. rhytidophyllum	18	C. and W. China
(Deciduous, rarely evergreen)		
Section ODONTOTINUS $x = 8, 9, 10$		
V. fœtidum	16	W. China
var. *rectangulatum*	16	Szechuan
V. Wrightii	16	Japan
V. lobophyllum	18*, 20, 22	C. and W. China
V. acerfolium	18	N. America
V. betulifolium	18	C. and W. China
V. ovatifolium	18	W. China
V. dentatum	54	N. America
(Deciduous)		
Section PSEUDOPULUS $x = 9$		
V. tomentosum	18	China, Japan
var. *mariesii*	18	Cult.
var. *sterile*	18	Cult.
Section OPULUS $x = 9$		
V. opulus	18	Europe, N. Africa, N. Asia
V. Sargentii *	18	N.-E. Asia
V. trilobum	13	N. America
Section LENTAGO $x = 9$		
V. lentago	18	W.-N. America
V. nudum	18	W.-N. America
V. prunifolium	18	W.-N. America
Section PSEUDOTINUS $x = 9$		
V. alnifolium	18	N. America
V. furcatum	18	Japan
(Evergreen)		
Section TINUS $x = 9$		
V. cinnamomifolium	18	W. China
V. Davidi	18	W. China
V. Tinus	36	S. E. Europe

* Count by Sax

$2n = 18$, the number reported by Sax for all the species of *Viburnum* he examined. Thus by artificial hybridization it has been possible to synthesize a plant with a basic number $x = 9$, not only common in *Viburnum*, but dominant for many genera belonging to the family Caprifoliaceæ.[1]

A chromosome survey of Viburnum species grown at The Royal Horticultural Society Gardens, Wisley, Royal Botanic Gardens, Kew, and the Jardin de Plantes, Paris, was next undertaken to study the natural distribution of these three numbers, $x = 8$, $x = 9$, $x = 10$ and to see what relationship, if any, existed between these numbers and the classification of the genus. The results are presented in Table I in which the species I studied are arranged under the 8 sections based on the classification of Rehder.[4]

There are about 120 species included in the genus *Viburnum*. These are distributed from the arctic regions of Alaska and Labrador down to the warmer regions of Central America, N. Africa and Asia as far as Java. Only three species are European while more than half the total number belong to Asia. Taxonomically, *Viburnum* species fall into two main classes—those in which the inflorescence is *paniculate* and those in which it is *umbellate*. The species with paniculate inflorescence—the THYROSOMA Section of Rehder to which belong *V. fragrans* and *V. grandiflora*, are exclusively Asian, being distributed from the Himalayas to Japan and N. Asia. They are predominantly deciduous and often precociously flowering, the exceptions being *V. odoratissimum* and *V. suspensum*. The basic chromosome number of all the deciduous species of this group is $x = 8$. Noteworthy is the fact that high polyploids occur in this section and they are found not only in the region of the Sino Himalayas—a region of high evolutionary activity in S.-E. Asia,[3] but also on the isolated mountains of Peninsular India. Thus THYROSOMA evidently had once a wide and continuous distribution in the flora of Asia and is definitely a relic at the present time.

The white form of *V. fragrans* is the only tetraploid I found in this section and it probably arose in cultivation in China. The place of the evergreen *V. odoratissimum* with a "secondary" $x = 10$ basic number, in this section, is explained, when we examine the cytological picture presented by the umbellate flowered LANTANA and ODONTOTINUS sections, where also deciduous and evergreen species are included (see Table). The presence of a few related species with $2n = 20$ in areas of diploids ($2n = 16$) can only mean that they have arisen from them and the genetic relationships of *V. bitchiuense* ($2n = 16$) and *V. Carlesii* ($2n = 20$) the two parents of *V. Juddii* ($2n = 18$) can be explained if we consider *V. Carlesii* ($2n = 20$) as having arisen as a backcross between a chance triploid ($2n = 24$) of *V. bitchiuense* with the normal diploid ($2n = 16$) form, as follows ($2n = 24$) $\times$ ($2n = 16$) $=$ ($2n = 20$) (see Fig. 1):—

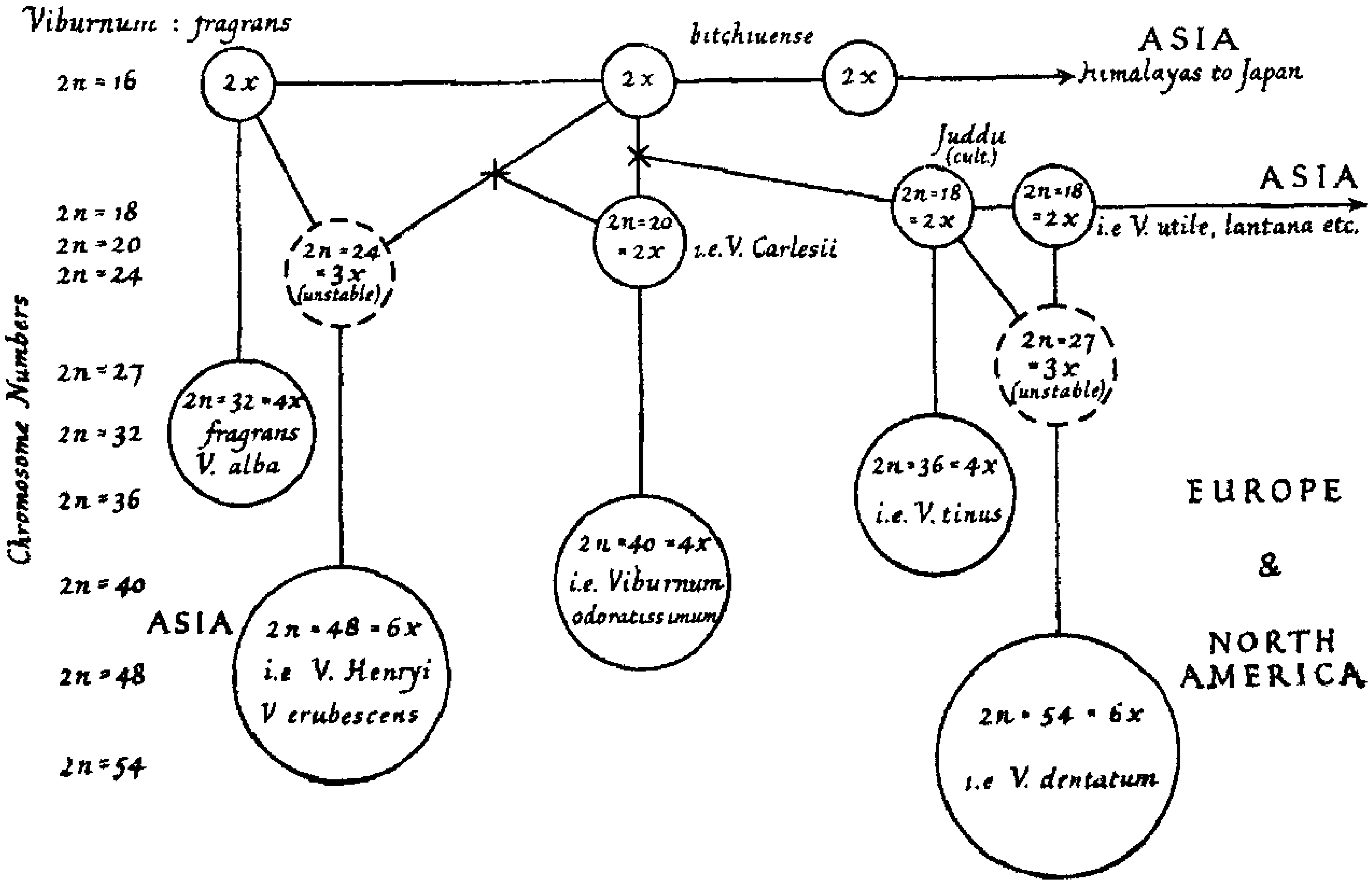


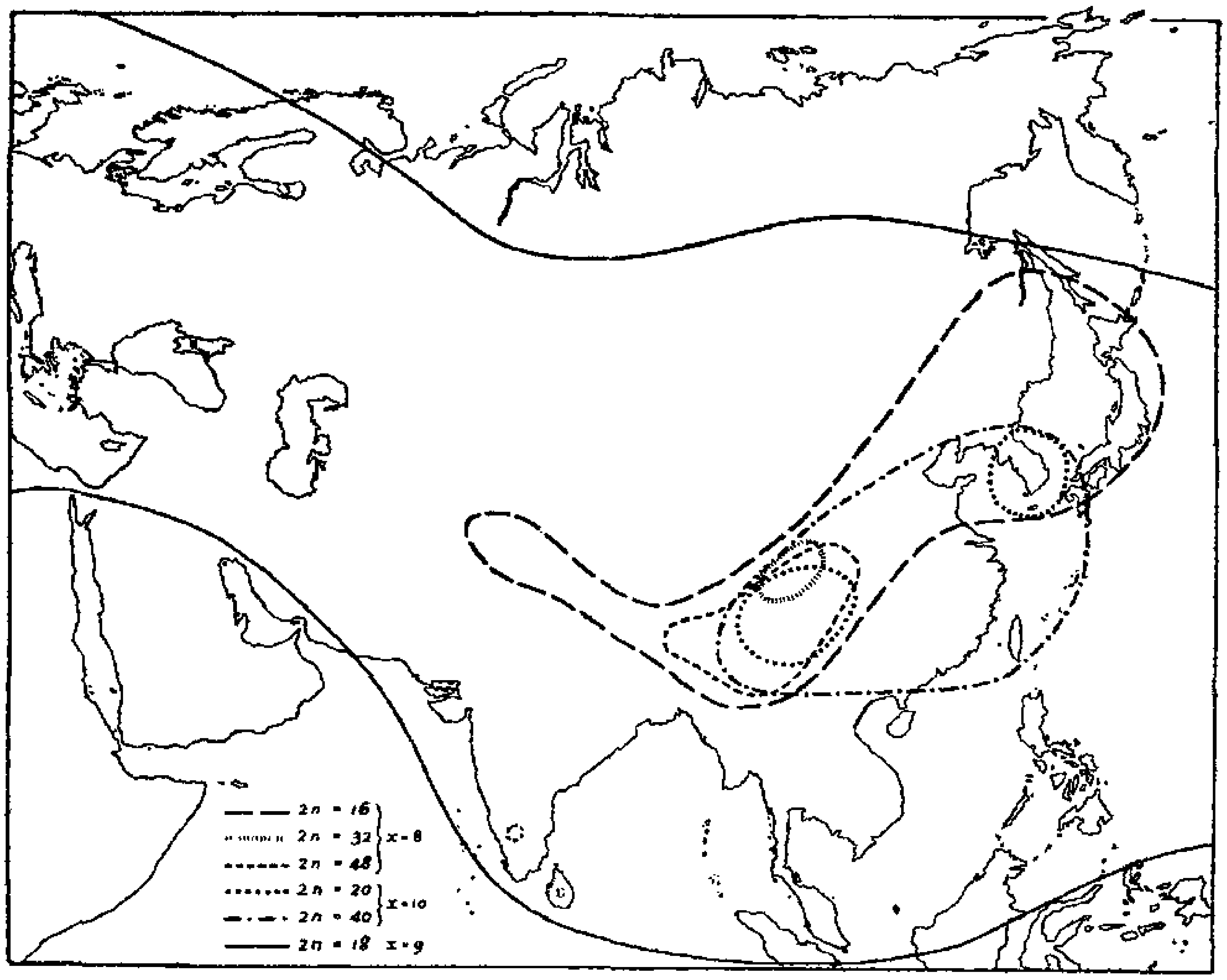
FIG. 1. Scheme of Chromosomes in *Viburnum*.

Triploids are commonly produced in nature and abundantly in cultivation. Their presence in a population of perennial woody plants as *Viburnum* can be a constant menace to the stability of diploids owing to the continued hybridization that can take place between them and diploids. They are a source of perennial contamination of extra chromosomes and thus become a cause of new directives in the evolution of the species. In *V. lobophyllum*, a species closely related to *V. Wrightii* ($2n = 16$) three chromosomal forms were noted. The plant I examined had $2n = 20$ like *V. Carlesii*, while a plant of *V. lobophyllum* from Exbury was found to have $2n = 22$ by Enoch (unpublished). (This number is the dominant one for the family Rubiaceæ, most closely related to Caprifoliaceæ.) The plant studied by Sax had $2n = 18$. Thus we can say that what happened in the garden in the production of *V. Juddii* ($2n = 18$) has also been happening in nature in the evolution of species in *Viburnum*. This has finally resulted in a stable population of a large number of species with the "tertiary" basic number $x = 9$ commonly found in the family Caprifoliacæ

All the species included in sections Pseudopulus, Opulus, Lentago and Pseudotinus by the botanist are "tertiary" diploids ($2n = 18$). They are found widely distributed in both the old and new world. It is a significantly remarkable fact that all the American *Viburnums* so far examined have only this "tertiary" basic number $x = 9$. The highest polyploid I found in this section, the hexaploid *V. dentatum* ($2n = 54$) is also N. American.

The evergreen *V. tinus* ($2n = 36$) is the only "tertiary" polyploid *Viburnum* I found in the old world. It is one of the few species of *Viburnum* that survived the Ice Age in Europe. It is very likely that varieties of this species with larger flowers which are known in cultivation will be found to be even higher polyploids.

In the accompanying Map, I have shown the distribution of diploid and polyploid species of *Viburnum* in Asia. The significance of the Sino-Himalayas as a region of a high evolutionary activity in species of *Viburnum* in Asia is shown by the distribution of high polyploids in that area.



DISTRIBUTION OF POLYPLOID VIBURNUMS IN ASIA

FIG. 2.

The diagrammatic scheme (Fig. 1), explains the relationship between chromosome numbers and the origin of species in the genus *Viburnum*.

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1. Darlington, C. D and Janaki Ammal, E. K, *Chromosome Atlas of Cultivated Plants*, Allen & Unwin, London, 1945 2. Farrer, R., *On the Eaves of the Word*, Edward Arnold, London, 1917. 3. Janaki Ammal, E. K., *Rhododendron Year Book*, 1950, 78. 4. Rehder, A., *A Manual of Cultivated Plants and Shrubs*, New York, 1940. 5 Sax, K. and Kribs, D. A., *Jour. Arnold Abor.*, 1930, **11**, 147. 6. Simonet and Miedzyrzeski, *C. R. Biol.*, Paris, 1932, **111**, 969 7. Sugiura, T., *Cytologia*, 1936, **7**, 544.